COLORADO RIVER RECOVERY PROGRAM Project No.: NEW-1
FY-2006–2007 PROPOSED SCOPE OF WORK for:
Guide to Cyprinid Larvae

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Category:	Expected Funding Source:
_ Ongoing project	x Annual funds
_ Ongoing-revised project	_ Capital funds
x Requested new project	x Other (Co-Sponsors
_ Unsolicited proposal	being sought)

I. Title of Proposal:
Guide to Cyprinid Larvae and Early Juveniles of the Upper Colorado River Basin with Computer-Interactive Key.

II. Relationship to RIPRAP:
General Recovery Program Support Action Plan items V.B (conduct research to acquire needed life history information) and V.C (develop and enhance scientific techniques required to complete recovery actions).

III. Study Background/Rationale and Hypotheses:
Collections of the early life stages of fish are essential for research on and monitoring of Colorado pikeminnow, humpback chub, bonytail, and other fish spawning sites and seasons, larval production, transport, distribution, nursery habitat, and survival, as well as other aspects of early life history. Such research cannot proceed effectively without accurate identification of at least the target species among collected specimens.
Morphological identification requires knowledge of the appearance of not only the target species but all similar species in the waters sampled and the diagnostic criteria for segregating them. For the early life stages of many species, including the catostomids (suckers) and cyprinids (minnows) of the Upper Colorado River Basin (UCRB), morphological criteria for identification change dramatically as the fish grow and develop, making diagnosis especially difficult and complicated. This is well exemplified by the 60-

page key by Snyder and Muth (1990) which covers the larvae and early juveniles of just six of the seven species of catostomids in the UCRB.

Descriptive information and diagnostic criteria for larval fish identification must be well founded, sufficiently detailed, and documented in such a way that they are retrievable, usable, and verifiable by any interested researcher, now or in the distant future. Any such knowledge retained only in the minds of one or a few specialists cannot be effectively used, verified, or further developed by others. Taxonomic expertise must be shared and transferred to avoid risk of sudden loss and need for rediscovery and redevelopment.

Nearly 25 years ago the Larval Fish Laboratory published *Contributions to a Guide to the Cypriniform Fish Larvae of the Upper Colorado River System in Colorado* through the U.S. Bureau of Land Management (Snyder 1981). That document, which was based on descriptive information and illustrations from the literature and several developmental studies funded in part by the Colorado Division of Wildlife, was intended to serve as the foundation for a comprehensive guide. With publication of the guide to catostomid larvae by Snyder and Muth (1990) and the recent expansion and update thereof with a computer-interactive key (Snyder and Muth 2004), Part 1 of the cypriniform guide is now complete and only the cyprinid portion of the 1981 publication, Part 2, remains to be similarly completed.

In 1990, Dr. Robert Muth completed a doctoral dissertation documenting the early morphological development of roundtail chub (*Gila robusta*), the endangered humpback chub (*G. cypha*), and the endangered, nearly extirpated, bonytail (*G. elegans*). His detailed and well-illustrated species accounts purposely followed the format employed by Snyder and Muth (1990) for catostomid larvae and required little modification for inclusion of roundtail chub and bonytail in a similarly formatted final-report guide to *Native Cypriniform Fish Larvae of the Gila River Basin* (Snyder et al. 2005). Species accounts for Colorado pikeminnow (*Ptychocheilus lucius*), speckled dace (*Rhinichthys osculus*), carp (*Cyprinus carpio*), red shiner (*Cyprinella lutrensis*), and fathead minnow (*Pimephales promelas*) were similarly adapted and minimally updated from Snyder (1981) for the Gila River Basin guide. However, the data in most of these accounts still remain incomplete and new three-view illustrations will be needed for all but the roundtail chub account in the proposed guide to cyprinid larvae of the UCRB.

Developmental series, mensural and meristic data, and (or) illustrations are needed to complete early life stage descriptive accounts for 13 of the 15 species of to be covered by this guide. Complete sets of 8 three-view drawings are available only for humpback chub, roundtail chub, and Colorado pikeminnow. However, two the drawings for Colorado pikeminnow from Seethaler (1978) should be replaced with more complete or representative illustrations. Much of the specimen material for needed developmental studies is available as part of the Larval Fish Laboratory Collection. However, full series of specimens for four species and just the eggs and recently hatched larvae (protolarvae) for four additional species will need to be reared, collected, or borrowed from elsewhere.

Computer-interactive keys for catostomid larvae of the UCRB (Snyder and Muth 2004) and for the larvae of native catostomids, selected cyprinids, and families of fishes in the Gila River Basin (Snyder et al. 2005) have proven that such taxonomic tools can be effectively applied to the early life stages of fish. For complex data sets, such keys are much more user friendly and flexible than printed dichotomous or polychotomus keys.

They are also much easier to prepare, correct, and update. The cyprinid and family level keys prepared for Snyder et al. (2005) will be adapted and refined for UCRB species.

Building on information, species accounts, and keys already assembled by Snyder (1981), Muth (1990), and Snyder et al. (1995) and other information and illustrations from the literature, this four-year project will result in a comprehensive guide to the cyprinid larvae and early juveniles of the UCRB. Combined with the recent update and expansion of the catostomid guide (Snyder and Muth 2004), this project will finally complete work on cypriniform fish larvae as a whole, except for formal publication. Publication will be pursued separate from this project as the manuscript nears completion, preferably as a companion to the catostomid guide recently published by the Colorado Division of Wildlife.

IV. Study Goals, Objectives, End Product: *[Include measurable outcomes and their expected due dates.]*

Goal—

- To improve the ability of Recovery Program and other researchers to accurately identify cyprinid larvae and early juveniles collected in the UCRB.

Objectives—

- To fully document the early morphological development of UCRB cyprinids and publish selected descriptions in technical journals.
- To verify existing, and uncover new, diagnostic criteria for identification of cyprinid larvae and early juveniles.
- To prepare a computer-interactive key to cyprinid larvae and early juveniles complementary to the key for UCRB catostomids (Snyder and Muth 2004) and comparable to the key for selected Gila River Basin cyprinids (Snyder et al. 2005).
- To prepare as manuscript guide to the cyprinid larvae and early juveniles of the UCRB with a proposal for its publication (both print and electronic).

End Products—

- Annual project reports.
- Preserved developmental series of the early life stages of needed cyprinids for study and reference to supplement existing specimens in the LFL Collection.
- Publication of selected descriptions in technical journals.
- Online (web) access to the key.
- Proposal for publication of that manuscript.
- Final report in the form of a manuscript guide for publication.

V. Study Area: Entire UCRB.

VI. Study Methods/Approach:

Task 1: Acquisition of specimens needed for developmental study (Table 1)—

- Assemble available specimens in the LFL Collection.
- Borrow needed specimens available in other museums and collections.
- Arrange for cooperative preservation of needed developmental series by fish hatcheries or other facilities rearing those species.

- Rear remaining needed developmental series from collected eggs and larvae or from artificially fertilized eggs from captured brood stock.
- Supplement above, as needed, with targeted or opportunistic collections of larvae and early juveniles.

Task 2: Description and illustration of eggs, larvae, and early juveniles of UCRB cyprinids, as needed (Table 1)—

- Determine or verify unique size or shape characters of eggs and conduct or complete detailed study of the morphological ontogeny of the larvae and early juveniles of each species, including meristics, morphometrics, size relative to state of development, gut morphology, and pigmentation as in prior descriptions (Snyder 1981, Muth 1990, Snyder and Muth 1990 and 2004, Snyder et al. 2005).
- Prepare or complete standard sets of eight three-view drawings of larvae and juveniles.
- Prepare or complete descriptive species accounts comparable to those in Snyder and Muth (1990, 2004) and Snyder et al. (2005).
- Compare above data and observations for diagnostically useful characters and summarize criteria for identification.

Task 3. Preparation of computer-interactive key to the larvae and early juveniles of UCRB cyprinids—

- Prepare or refine descriptive data assembled for above species accounts in DELTA format for use by INTKEY (Dallwitz 1993; Dallwitz et al. 1993 et seq., 1995 et seq., and 1999 et seq.) in a manner comparable to that previously prepared for UCRB catostomids and Gila River Basin catostomids and cyprinids; prepare, test, and refine a draft version of the computer-interactive key for UCRB cyprinids.
- Modify introduction and instructions previously prepared for the computer-interactive key to UCRB catostomids for use with the key for UCRB cyprinids.
- Submit draft key and instructions for use of the computer-interactive key to critical review and testing by LFL staff and external volunteers (e.g., USFWS, CDOW, or UDWR researchers, and Dr. Dallwitz) and refine and finalize the key and instructions accordingly.

Task 4. Synthesis, publication, presentation, and reporting of results—

- Prepare and submit annual project (progress) reports.
- Present papers on development and identification of UCRB cyprinids with hands-on demonstration of draft and final computer-interactive key at annual Larval Fish Conferences (American Fisheries Society Early Life History Section) and annual meetings of UCRB researchers (use feedback on draft versions of the key to further refine the key). Presentations may be opportunistically offered at annual meetings of the American Fisheries Society (AFS), AFS Western Division, AFS Colorado/Wyoming Chapter, American Society of Ichthyologists and Herpetologists, and Desert Fishes Council.
- Prepare and submit descriptions of selected species for publication in technical journals.
- Prepare and submit the project final report to the Recovery Program and other co-sponsors of the project. The report will consist of the manuscript guide to cyprinid larvae of the UCRB with the computer-interactive key on an companion CD-ROM

disk; like the catostomid guide and key, both will be made available for viewing or download over the Internet.

- Prepare and submit proposal(s) for print publication of the cyprinid guide.

VII. Task Description and Schedule:

Task 1: Acquisition of specimens needed for developmental study—FY 2006-2007 (possibly beginning in July 2005 if funded early by a co-sponsor).

Task 2: Description and illustration of eggs, larvae, and early juveniles—FY 2006-2008.

Task 3: Preparation of computer-interactive key—FY 2006-2009.

Task 4: Synthesis, publication, presentation, and reporting of results—FY 2006-2009.

Note: If progress during the first two years of the project exceed expectations, the last two years could be combined, concluding the project in three rather than four years.

VIII. FY-2006 Work:

– Deliverables/Due Dates:
  - Annual report—November or December 2006.

– Budget (to be prospectively cost-shared at about one-third by the Recovery Program and two-thirds by yet-to-be-identified co-sponsors): [a]

Task 1 (Acquisition of specimens)	LFL
Labor	
Principal Investigator ($5,673/mo.[b]; 1.21 mo.)	$6,855
Research Associate(s) ($2,878/mo.[b]; 4.49 mo.)	12,923
Travel (to acquire ripe fish or eggs for culture)	
Vehicle (5 wk)	1,025
Per diem and lodging (25 d, motel/camping for 2)	1,380
Supplies [c]	300
Total Direct Costs	22,483
Indirect Cost (15% TDC) [d]	3,372
Task 1 Subtotal (Direct & Indirect Costs)	25,855

Task 2 (Description and illustration)	
Labor	
Principal Investigator ($5,673/mo.[b]; 2.74 mo.)	$15,530
Research Associate(s) ($2,878/mo.[b]; 2.09 mo.)	6,014
Illustrator ($4,136/mo.[b]; 5.38 mo.)	22,241
Equipment [e]	
Image analysis program (software)	2,000
High-resolution camera	2,000
Frame grabber	1,000
Supplies [f]	155
Services [g]	450
Total Direct Costs	49,890
Indirect Cost (15% TDC) [d]	7,483
Task 2 Subtotal (Direct & Indirect Costs)	57,373

Task 3 (Preparation of computer-interactive key)	
Labor	
Principal Investigator ($5,673/mo.[b]; 0.36 mo.)	$2,016
Research Associate(s) ($2,878/mo.[b]; 0.15 mo.)	427
Total Direct Costs	2,443
Indirect Cost (15% TDC) [d]	366
Task 3 Subtotal (Direct & Indirect Costs)	2,809
Task 4 (Synthesis and communication of results)	
Labor	
Principal Investigator ($5,673/mo.[b]; 0.92 mo.)	$5,242
Research Associate(s) ($2,878/mo.[b]; 0.01 mo.)	43
Travel [h]	
Larval Fish Conference (1 person)	
Airfare and ground transport	500
Per diem (5 d) and lodging (4 nights)	405
Registration	100
Total Direct Costs	6,290
Indirect Cost (15% TDC) [d]	943
Task 4 Subtotal (Direct & Indirect Costs)	7,233
FY 2006 TOTAL	$93,270
Recovery Program share (one third)	31,090
(Amount tentatively budgeted by RP for FY2006: $13,500) [i]	
Co-sponsors (two thirds)	$62,180
(Difference from RP's budget allotment: $79,770) [i]	

[a] Annual estimated increases in fringe benefit rates (generally + 0.5%) and salary and other expenses (x 4%) are specified by the University Office of the Vice President for Research and Information Technology it's current Proposal Budget Spreadsheet.

[b] Salary plus fringe benefits (see salary schedule below).

[c] Drawing, photographic, presentation and rearing supplies.

[d] Assumes MOU in which the University covers the remainder of the standard 45% indirect cost rate.

[e] Upgrades to computer image analysis system (new host computer for system previously secured through another project and new research microscope previously provided by college and department in support of LFL).

[f] Project-specific computer, lab, drawing, photographic, and specimen preservation and storage supplies.

[g] Photographic services (high-resolution scanning of drawings).

[h] Travel costs for participation in Recovery Program Researchers' Meeting are expected to be covered by another project.

[i] Recovery Program Guidance for FY06-07 estimated a total cost of $40,600 for FY 2006, but that figure represents the first year direct costs from the proposed SOW we submitted for FY 2001 (March 2000; total with indirect costs was $46,700). In previously submitted SOWs, the first year of this four-year

project was purposely lean because of other commitments by the principal investigator. In the current version, the distribution of effort is more balanced and greater during the first two years.

Salary Schedules for FY-2006 (monthly):

Position	Salary[a]	Benefits[a]	Total
Principal Investigator	$4,716	$957	$5,673
Research Associate(s)	$2,392	$486	$2,878
Illustrator	$3,425	$711	$4,136

[a] Salaries and benefits are adjusted for the federal FY (fiscal year beginning Oct. 1) with 3/4 from Colorado State FY 05/06 (beginning July 1) and 1/4 from Colorado State FY 06/07. Vacation, holiday, and sick leave (not included in benefits) are included in adjustments to the amount of budgeted effort (months).

FY-2007 Work

- Deliverables/Due Dates:
  - Presentation of selected descriptions—Larval Fish Conference, Spring or Summer 2007, possibly also RP Researchers' Meeting, January 2007.
  - Annual report—November or December 2007.

- Budget (to be prospectively cost-shared at about one-third by the Recovery Program and two-thirds by yet-to-be-identified co-sponsors): [a]

Task 1 (Acquisition of specimens)	LFL
Labor	
Principal Investigator ($5,906/mo.[b]; 0.78 mo.)	$4,617
Research Associate(s) ($2,996/mo.[b]; 4.37 mo.)	13,099
Travel (to acquire ripe fish or eggs for culture)	
Vehicle (5 wk)	1,066
Per diem and lodging (25 d, motel/camping for 2)	1,435
Supplies [c]	300
Total Direct Costs	20,517
Indirect Cost (15% TDC) [d]	3,078
Task 1 Subtotal (Direct & Indirect Costs)	23,595

Task 2 (Description and illustration)	
Labor	
Principal Investigator ($5,906/mo.[b]; 2.74 mo.)	$16,168
Research Associate(s) ($2,996/mo.[b]; 2.09 mo.)	6,261
Illustrator ($4,332/mo.[b]; 5.38 mo.)	23,298
Supplies [e]	555
Services [f]	450
Total Direct Costs	46,732
Indirect Cost (15% TDC) [d]	7,010
Task 2 Subtotal (Direct & Indirect Costs)	53,742

Task 3 (Preparation of computer-interactive key)	
Labor	
Principal Investigator ($5,906/mo.[b]; 0.53 mo.)	$3,148
Research Associate(s) ($2,996/mo.[b]; 0.22 mo.)	666
Total Direct Costs	3,814
Indirect Cost (15% TDC) [d]	572
Task 3 Subtotal (Direct & Indirect Costs)	4,386
Task 4 (Synthesis and communication of results)	
Labor	
Principal Investigator ($5,906/mo.[b]; 1.28 mo.)	$7,556
Research Associate(s) ($2,996/mo.[b]; 0.07 mo.)	222
Travel [g]	
Larval Fish Conference (1 person)	
Airfare and ground transport	520
Per diem (5 d) and lodging (4 nights)	421
Registration	104
Supplies [h]	50
Total Direct Costs	8,873
Indirect Cost (15% TDC) [d]	1,331
Task 4 Subtotal (Direct & Indirect Costs)	10,204
FY 2007 TOTAL	$91,927
Recovery Program share (one third)	30,642
(Amount tentatively budgeted by RP for FY2007: $30,000) [i]	
Co-sponsors (two thirds)	61,285
(Difference from RP's budget allotment: $61,927) [i]	

[a] Annual estimated increases in fringe benefit rates (generally + 0.5%) and salary and other expenses (x 4%) are specified by the University Office of the Vice President for Research and Information Technology it's current Proposal Budget Spreadsheet.

[b] Salary plus fringe benefits (see salary schedule below).

[c] Drawing, photographic, presentation and rearing supplies.

[d] Assumes MOU in which the University covers the remainder of the standard 45% indirect cost rate.

[e] Software upgrades and project-specific computer, lab, drawing, photographic, and specimen preservation and storage supplies.

[f] Photographic services (high-resolution scanning of drawings).

[g] Travel costs for participation in Recovery Program Researchers' Meeting are expected to be covered by another project.

[h] Drawing, photographic, and presentation supplies.

[i] Recovery Program Guidance for FY06-07 estimated a total cost of $89,900 for FY 2007, but that figure represents the second year direct costs from the proposed SOW we submitted for FY 2001 (March 2000; total with indirect costs was $103,345. Co-incidentally, as a result of redistribution of effort, the current SOW total for FY2007 closely approximates the RP figure.

Salary Schedules for FY-2007 (monthly):

Position	Salary[a]	Benefits[a]	Total
Principal Investigator	$4,904	$1,002	$5,906
Research Associate(s)	$2,488	$508	$2,996
Illustrator	$3,562	$770	$4,332

[a] Salaries and benefits are adjusted for the federal FY (fiscal year beginning Oct. 1) with 3/4 from Colorado State FY 06/07 (beginning July 1) and 1/4 from Colorado State FY 07/08. Vacation, holiday, and sick leave (not included in benefits) are included in adjustments to the amount of budgeted effort (months).

FY-2008 Work:

– Deliverables/Due Dates:
  - Presentations of selected descriptions and draft computer-interactive key—Recovery Program Researchers' Meeting, January 2008, and Larval Fish Conference, Spring or Summer 2008.
  - Annual report—November or December 2008.

– Budget (to be prospectively cost-shared at about one-third by the Recovery Program and two-thirds by yet-to-be-identified co-sponsors): [a]

Task 1 (Acquisition of specimens)	LFL
Completed	
Task 1 Subtotal (Direct & Indirect Costs)	0
Task 2 (Description and illustration)	
Labor	
Principal Investigator ($6,167/mo.[b]; 3.43 mo.)	$21,136
Research Associate(s) ($3,129/mo.[b]; 2.77 mo.)	8,671
Illustrator ($4,524/mo.[b]; 2.69 mo.)	12,165
Supplies [c]	155
Services [d]	450
Total Direct Costs	42,577
Indirect Cost (15% TDC) [e]	6,387
Task 2 Subtotal (Direct & Indirect Costs)	48,964
Task 3 (Preparation of computer-interactive key)	
Labor	
Principal Investigator ($6,167/mo.[b]; 1.10 mo.)	$6,795
Research Associate(s) ($3,129/mo.[b]; 0.56 mo.)	1,762
Supplies [f]	100
Total Direct Costs	8,657
Indirect Cost (15% TDC) [d]	1,298
Task 3 Subtotal (Direct & Indirect Costs)	9,955

Task 4 (Synthesis and communication of results)	
Labor	
Principal Investigator ($6,167/mo.[b]; 1.63 mo.)	$10,082
Research Associate(s) ($3,129/mo.[b]; 0.13 mo.)	417
Travel [g]	
Larval Fish Conference (1 person)	
Airfare and ground transport	541
Per diem (5 d) and lodging (4 nights)	438
Registration	108
Supplies [h]	50
Services	
Primary publication page charges	2,000
Total Direct Costs	13,636
Indirect Cost (15% TDC) [d]	2,046
Task 4 Subtotal (Direct & Indirect Costs)	15,682
FY 2008 TOTAL	$74,602
Recovery Program share (one third)	24,867
Co-sponsors (two thirds)	49,735

[a] Annual estimated increases in fringe benefit rates (generally + 0.5%) and salary and other expenses (x 4%) are specified by the University Office of the Vice President for Research and Information Technology it's current Proposal Budget Spreadsheet.

[b] Salary plus fringe benefits (see salary schedule below).

[c] Project-specific computer, lab, drawing, photographic, and specimen preservation and storage supplies.

[d] Photographic services (high-resolution scanning of drawings).

[e] Assumes MOU in which the University covers the remainder of the standard 45% indirect cost rate.

[f] Project-specific computer and lab supplies.

[g] Travel costs for participation in Recovery Program Researchers' Meeting are expected to be covered by another project.

[h] Drawing, photographic, and presentation supplies.

Salary Schedules for FY-2008 (monthly):

Position	Salary[a]	Benefits[a]	Total
Principal Investigator	$5,100	$1,067	$6,167
Research Associate(s)	$2,588	$541	$3,129
Illustrator	$3,704	$820	$4,524

[a] Salaries and benefits are adjusted for the federal FY (fiscal year beginning Oct. 1) with 3/4 from Colorado State FY 07/08 (beginning July 1) and 1/4 from Colorado State FY 08/09. Vacation, holiday, and sick leave (not included in benefits) are included in adjustments to the amount of budgeted effort (months).

FY-2009 Work:

- Deliverables/Due Dates:
  - Presentations of selected descriptions and final computer-interactive key—Recovery Program Researchers' Meeting, January 2009 and Larval Fish Conference, Spring or Summer 2009.
  - Proposal for publication of guide to larvae and early juveniles of UCRB cyprinids and catostomids with computer-interactive keys on diskette or CD and as web documents—Spring 2009.
  - Final report consisting of manuscript for the guide to UCRB cyprinid larvae and the computer-interactive key—submission of draft final report targeted for Spring 2009 with final due in September 2009.

- Budget (to be prospectively cost-shared at about one-third by the Recovery Program and two-thirds by yet-to-be-identified co-sponsors): [a]

Tasks 1 and 2 (Acquisition of specimens, description)	LFL
Completed	
Task 1and 2 Subtotal (Direct & Indirect Costs)	0
Task 3 (Preparation of computer-interactive key)	
Labor	
Principal Investigator ($6,441/mo.[b]; 0.18 mo.)	$1,144
Total Direct Costs	1,144
Indirect Cost (15% TDC) [c]	172
Task 3 Subtotal (Direct & Indirect Costs)	1,316
Task 4 (Synthesis and communication of results)	
Labor	
Principal Investigator ($6,441/mo.[b]; 2.84 mo.)	$18,311
Research Associate(s) ($3,268/mo.[b]; 0.47 mo.)	1,550
Travel [d]	
Larval Fish Conference (1 person)	
Airfare and ground transport	563
Per diem (5 d) and lodging (4 nights)	456
Registration	112
Supplies [e]	150
Services	
Primary publication page charges	2,000
Copying and binding final report	1,000
Total Direct Costs	24,142
Indirect Cost (15% TDC) [c]	3,621
Task 4 Subtotal (Direct & Indirect Costs)	27,763
FY 2009 TOTAL	$29,079
Recovery Program share (one third)	9,693
Co-sponsors (two thirds)	19,386

[a] Annual estimated increases in fringe benefit rates (generally + 0.5%) and salary and other expenses (x 4%) are specified by the University Office of the Vice President for Research and Information Technology it's current Proposal Budget Spreadsheet.

[b] Salary plus fringe benefits (see salary schedule below).

[c] Assumes MOU in which the University covers the remainder of the standard 45% indirect cost rate.

[d] Travel costs for participation in Recovery Program Researchers' Meeting are expected to be covered by another project.

[e] Project-specific computer, lab, drawing, photographic, and presentation supplies.

Salary Schedules for FY-2009 (monthly):

Position	Salary[a]	Benefits[a]	Total
Principal Investigator	$5,304	$1,137	$6,441
Research Associate(s)	$2,691	$577	$3,268

[a] Salaries and benefits are adjusted for the federal FY (fiscal year beginning Oct. 1) with 3/4 from Colorado State FY 08/09 (beginning July 1) and 1/4 from Colorado State FY 09/10. Vacation, holiday, and sick leave (not included in benefits) are included in adjustments to the amount of budgeted effort (months).

IX. Budget Summary:

FY-2006	$93,270
FY-2007	91,927
Subtotal	185,197
FY-2008	$74,602
FY-2009	29,079
Subtotal	103,681
Total:	$288,878

X. Reviewers:

Versions of this proposal have been submitted to the Recovery Program periodically since 1990. This is a modification of the version submitted to the Recovery Program for FY 2001 and FY 2004-2005 funding and that has been included in Program Guidance since FY 2004-2005, and through such has been reviewed several times by members of the Biology Committee and probably others in the Recovery Program.

XI. References:

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TABLE 1. Specimens, illustrations, and data needed for an illustrated manual and computer-interactive key for larval and early juvenile cyprinids of the Upper Colorado River Basin. F = full set needed, P = partial set needed, P/F = partial set needed but full set preferred (available published illustrations may not of desired quality), H = only embryos and recently hatched specimens needed. Existing mensural and count data for most species will need to be verified. All species will need to be examined for qualitative and quantitative documentation of pigmentation patterns and structural features.

	Study Specimens Needed	Mensural & Count Data Needed	3-View Illustrations (Drawings) Needed
Cyprinella lutrensis red shiner	H	H	P/F
Cyprinus carpio common carp	–	–	P/F
Gila atraria Utah chub	F	P	P/F
Gila cypha humpback chub	–	–	–
Gila elegans bonytail	–	–	P
Gila robusta roundtail chub	–	–	–
Hybognathus hankinsoni brassy minnow	F	F	F
Notropis stramineus sand shiner	H	H	F
Pimephales promelas fathead minnow	–	P	P
Ptychocheilus lucius Colorado pikeminnow	–	–	P
Rhinichthys cataractae longnose dace	F	F	P/F
Rhinichthys osculus speckled dace	H	H	H
Richardsonius balteatus redside shiner	H	H	H
Semotilus atromaculatus creek chub	F	F	P
Notemigonus crysoleucas [a] golden shiner	–	P	P

[a] Non-native species rarely reported in the basin.